The Office of Environment, Safety and Health and its Office of Nuclear and Facility Safety (NFS) publishes the Operating Experience Weekly Summary to promote safety throughout the Department of Energy (DOE) complex by encouraging feedback of operating experience and encouraging the exchange of information among DOE nuclear facilities.

The Weekly Summary should be processed as an external source of lessons-learned information as described in DOE-STD-7501-96, *Development of DOE Lessons Learned Programs*.

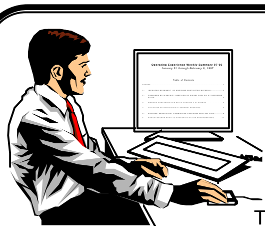
To issue the Weekly Summary in a timely manner, the Office of Operating Experience Analysis and Feedback (OEAF) relies on preliminary information such as daily operations reports, notification reports, and, time permitting, conversations with cognizant facility or DOE field office staff. If you have additional pertinent information or identify inaccurate statements in the summary, please bring this to the attention of Neil MacArthur, 301-540-2396, or Internet address neil.macarthur@hq.doe.gov, so we may issue a correction.

Readers are cautioned that review of the Weekly Summary should not be a substitute for a thorough review of the interim and final occurrence reports.

Operating Experience Weekly Summary 97-13

March 21 through March 27, 1997

Table of Contents



Visit Our Web Site

The Weekly Summary is available, with word search capability, via the Internet at **http://www.tis.eh.doe.gov/web/oeaf/oe_weekly/oe_weekly.html**. If you have difficulty accessing the Weekly Summary at this URL, please contact Mark Mortensen at 208-525-3753 for assistance.

EVENTS

1. FIRE PROTECTION SYSTEM DEFICIENCIES AT PADUCAH

Operating Experience Analysis and Feedback (OEAF) engineers reviewed three Nuclear Regulatory Commission event reports this week about fire protection system deficiencies at the Paducah Gaseous Diffusion Plant. The reports involved improperly oriented sprinkler heads, areas without adequate coverage, and an improperly located sprinkler system. Site fire department personnel identified the deficiencies during a March 19-24, 1997, comprehensive walk-down of the fire protection systems. The plant superintendent declared the affected systems inoperable and established the required hourly fire patrols. Investigators believe informal work controls used in the past, as well as management's failure to endorse a configuration management program until recently, caused the deficiencies. Failure to adequately evaluate work and manage configuration changes rendered fire protection systems inoperable. (NRC Event Report Number 31972, 32002, and 32012)

Investigators determined the process buildings were constructed in the 1950s. The fire sprinkler system was installed following a fire in one of the buildings in the late 1950s. Investigators also determined that structural changes were made about 1960. Investigators learned the plant fire department was not responsible for the fire protection systems in the process buildings until December 1, 1993. They also determined management did not establish formal work controls or enforce them until early in 1996, and management did not endorse configuration management before 1996. Plant fire department personnel are currently conducting a 100 percent walk-down of the fire protection systems for the process buildings to identify blocked or mispositioned sprinkler heads and any disconnected piping. They have identified the following deficiencies to date.

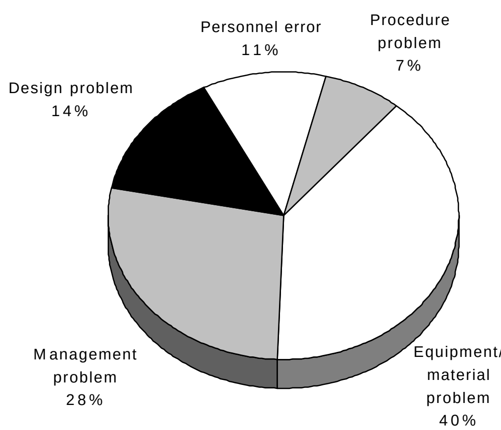
- sprinkler heads mounted at 45 degrees instead of vertically
- sprinkler heads obstructed by light fixtures, a utility piping system, and steel beams
- sprinkler system mounted too far from the ceiling
- areas without adequate sprinkler heads or fire protection system coverage
- sprinkler heads supplied with 1/2-inch pipe instead of the required 1-inch pipe

NFS reported work control and configuration management issues in Weekly Summaries 97-07 and 96-47.

- Weekly Summary 97-07 reported that on January 25, 1997, at the Oak Ridge Y12 site, during a quarterly test of a building criticality alarm system, testers raised the concern that the audible signal could not be heard during periods when processing equipment was operating. Investigators learned that installation of the new processing equipment changed the baseline noise data for the area and planners had not evaluated the noise level with respect to the criticality alarm system. (ORPS Report ORO--LMES-Y12SITE-1997-0008)

- Weekly Summary 96-47 reported that on November 12, 1996, at the Rocky Flats Environmental Technology Site, technical services engineers determined that differential pressures between two rooms could not be read on pressure differential indicating controllers. The engineers believed that modifications made before 1990 resulted in obstructed flow paths between the rooms. (ORPS Report RFO--KHLL-771OPS-1996-0179)

OEAF engineers reviewed the Occurrence Reporting and Processing System (ORPS) Graphical User Interface (GUI) for sprinkler head and fire system problems and found 810 occurrences. Figure 1-1 shows that facility managers reported equipment or material problems as the root cause for 40 percent of the occurrences and management problems as the root cause for 28 percent. Further review shows that 81 percent of the reported equipment/material problems were caused by defective or failed parts. Review of the management problems shows that facility managers reported 29 percent as inadequate administrative controls and 24 percent as work organization or planning deficiencies.



Management Problem	Percent
Inadequate administrative control	29
Work organization/Planning deficiency	24
Policy not communicated or enforced	20
Other management problem	20
Inadequate supervision	5
Improper resource allocation	2

Figure 1-1. Distribution of Root Causes for Fire System Problems[1]

These events illustrate the importance of thorough technical reviews and work controls of modifications and a disciplined configuration management program. Work controls and configuration management do not apply to any one discipline, but to all areas of a facility. They encompass any and all changes made or proposed to a facility or change of mission. Proposed modifications to a system need to be thoroughly reviewed, and the impact on the design basis of other systems should be evaluated. Facility managers should ensure all personnel are made aware of the need for stringent work controls and configuration management. Facility managers should also ensure that work controls and configuration management programs, verification, and approval are conducted by personnel qualified for the specific discipline involved. They should also ensure that verifications include the current codes for that particular discipline.

DOE-STD-1073-93, *Guide for Operational Configuration Management Program, Including the Adjunct Programs of Design Reconstitution and Material Condition and Aging*

[1] OEAF engineers searched the ORPS GUI for All Narrative, ("sprinkler head" or "fire" <near/2> "system") and fail and found 810 occurrence reports. Based on a random sample of 50 reports, OEAF determined that each pie slice is accurate to within ± 1 percent.

Management, Parts 1 and 2, addresses modification technical reviews as part of the change control element. Section 1.3.4.2 of the standard recommends that changes be reviewed and approved by the design authority prior to implementation. The section states these reviews should evaluate safety, environmental, and mission impacts and should determine post-implementation acceptance criteria. The standard also discusses the control of modifications that can lead to temporary or permanent changes in design requirements, facility configuration, or facility documentation. The standard discusses identifying changes, conducting technical and management reviews, and implementing and documenting changes. Change management is the process of maintaining the configuration of safety requirements, procedures, and controls in agreement with the mission and facility design configuration. The standard states that physical configuration assessments or walk-downs should be performed for representative sample structures, systems, and components within the facility to determine the degree of agreement between the physical configuration and the configuration on the facility documentation. Physical walk-downs should be included as part of the programmatic assessments conducted during initial assessments, post-implementation assessments, and periodic effectiveness assessments.

KEYWORDS: fire protection system, work control

FUNCTIONAL AREAS: configuration control, fire protection, industrial safety, work planning

2. LESSONS LEARNED ON SURVEY METHODS FOR IDENTIFYING BETA RADIATION

Operating Experience Analysis and Feedback engineers reviewed the final report for an event that occurred on August 16, 1996, at the Sandia National Laboratory, where a radiological control technician team supervisor discovered a single radioactive particle (hot particle) on the floor of a waste sorting room. Investigators believe the hot particle fell on the floor 14 days earlier while workers sorted hot cell waste. The particle read 166 rad/hr on contact, and radiological control technicians determined it was almost a pure beta emitter containing primarily strontium 90 with other isotopes. The beta-to-gamma emission ratio was 66,000 to 1. Survey methods used before the supervisor discovered the particle did not specifically screen for beta radiation because radiological control personnel assumed gamma radiation was always present when beta radiation was present. Technicians relied on swipe surveys and survey instruments that were not sensitive to beta radiation. Three workers in the sorting room received exposures from the hot particle. One of them had a calculated maximum shallow dose equivalent of 606 mrem. (ORPS Report ALO-KO-SNL-7000-1996-0012)

On October 22, 1996, the radiological operations staff held a meeting to discuss the need for establishing improved controls for hot particles. They evaluated modifications to monitoring and surveying techniques to detect hot particles and developed additional contamination controls to prevent the spread of hot particles.

A root cause analysis team determined that defective or inadequate procedure was the direct cause of the event. They determined the radiation survey procedures used for the work activity in the sorting room did not effectively identify beta dose rates in the absence of a corresponding gamma dose.

Facility managers and radiological operations managers identified the following lessons learned for radiation surveys and monitoring.

- The most reliable way to monitor for a physical phenomena is direct measurement of the phenomena rather than inference based on another measurement. Beta radiation is a well-known common hazard when dealing with radioactive material from the nuclear fuel cycle. Inferring its presence or absence using gamma survey results introduces unnecessary risk.

- Portable instrumentation, such as an RSO50, should have been used for monitoring cleanup of the sorting room instead of swipe surveys. The swipe surveys did not detect the hot particle on the floor. The RSO50 has a thin-window ion chamber for a detector and can detect medium- and high-energy betas as well as gammas.

- Portable survey instruments that use scintillation detectors should not be the only instruments used for contamination surveys. Scintillation type detectors are encased in a metal housing and have a greatly reduced sensitivity to beta radiation.

- When dealing with nuclear fuel cycle materials or waste, the presence of beta radiation without any corresponding gamma radiation should be anticipated. Sandia radiological operations staff have assumed for many years that there would always be gamma activity associated with beta activity. The gamma activity can be very low; in fact, so low as to prevent the recognition of a serious beta hazard.

This event demonstrates the importance of performing proper radiological surveys for beta particle contamination. Radiological control managers at DOE facilities should review their survey and monitoring techniques for finding beta contamination. DOE/EH-0256T, *Radiological Control Manual*, article 348, “Controls for Hot Particles,” states that hot particles are small, discrete, highly radioactive particles capable of causing extremely high doses to a localized area in a short period of time. Hot-particle contamination may be present or generated when contaminated systems are opened or when operations such as machining, cutting, or grinding are performed on highly radioactive materials. Article 554.8 states that areas identified as either contaminated with, or having the potential for being contaminated with, hot particles should be surveyed weekly. These areas should be surveyed at least daily during periods of work that may result in the generation of hot particles. Special swipe techniques to collect hot particles, such as tape and large area wipes, should be used.

Commercial nuclear industry experience with hot particles can be found in Electric Power Research Institute (EPRI) document TR-104125, *Industry Experience with Discrete Radioactive Particles*, issued in July 1994. The study is an extensive survey of the nuclear industry's experience with hot particles and describes the impact of hot particles in terms of radiation exposures, physiological and psychological stress on workers, productivity, and cost. Copies of TR-104125, in print or on microfiche, can be obtained by contacting the EPRI Distribution Center at (510) 934-4212.

National Council on Radiation Protection and Measurements (NCRP) Report No. 106, *Limit for Exposure to Hot Particles on the Skin*, assesses the biological effects of irradiation of the skin and evaluates radiobiological experiments with hot particles. An exposure limit is derived in terms of the number of beta particles emitted from a radioactive particle in contact with the skin. Copies of NCRP reports can be obtained by calling (301) 657-2652 or by Internet at http://www.ncrp.com.

KEYWORDS: radiation protection, hot particle, beta, radiation survey

FUNCTIONAL AREAS: radiation protection

3. FUEL-HANDLING CASK LIFTING DEVICE DOES NOT MEET DESIGN CRITERIA

On March 13, 1997, at the Idaho Chemical Processing Plant, engineering personnel discovered discrepancies between an equipment drawing for a fuel handling cask lifting device and the nameplate capacity. The drawing indicated a lifting device design capacity of 15 tons and the nameplate showed a capacity of 20 tons. Investigators reviewed the load-testing records for the lifting device and discovered it was last tested in 1993. Since 1985, it has been tested to 150 percent of the nameplate capacity eight times. However, testing was actually to 200 percent of the 15-ton design capacity. The facility manager removed the cask lifting device from service. Improper labeling of equipment and failure to verify the labeling as correct created the potential for injury or equipment damage. (ORPS Report ID--LITC-FUELRCSTR-1997-0004)

Investigators determined the lifting device has been used since 1977, and they believe it was site-fabricated. Investigators believe the in-field lifting capacity was changed in 1985. They also believe engineers tested the lifting device to 150 percent of its rated capacity, or 22.5 tons, and backed the "proposed rated capacity" down from 22.5 tons to 20 tons. Engineers then mistakenly marked the lifting device at 20 tons. Investigators determined that hand calculations made in 1985 showed the lifting device met the 5 to 1 ultimate load criteria; however, the lifting loop was not considered in these calculations.

Engineers determined that, because the lifting device was inadvertently tagged at 20 tons, it was routinely tested with a load of 31 tons. They performed a stress analysis using hand calculations and IDEAS™-based finite element analysis on the lifting device. The analysis indicated that routine load testing stressed the lifting device past the material yield point (stress) in the lifting loop and hook areas. Engineers estimated the lifting device has been over-stressed eight times since 1985. They found no material yielding or external visible adverse effects on the lifting device during their inspection. Further analysis of the lifting device indicates that several areas do not meet the safety factors stated in the plant safety documents. The plant safety documents for engineered safety features require lifting devices to be designed with a safety factor of five times the load rating. ASME B30.20-1993, *Below-The-Hook Lifting Device*, requires lifting devices to be designed with a safety factor of at least 3, based on the material yield strength. The five lifting device sections identified in Figure 3-1 do not meet the required yield strength safety factor of 3. Additionally, the loop and the hooks do not meet the material ultimate strength safety factor of 5.

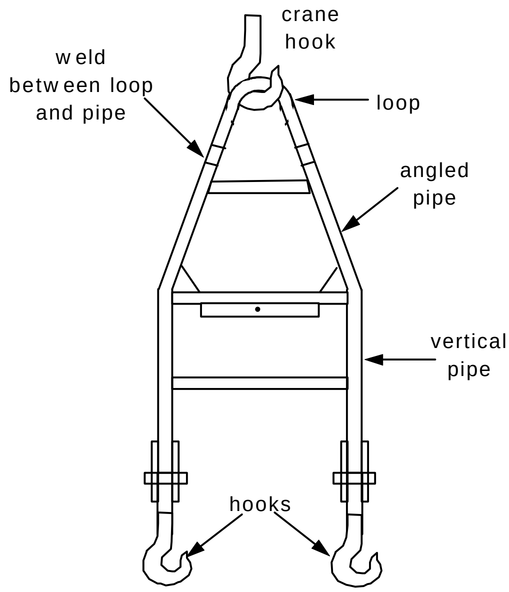


Figure 3-1. Lifting Device Assembly

The facility manager directed engineering personnel to check other lifting devices fabricated during the 1977 era to ensure engineering stress requirements are being met. Engineers are continuing to investigate to determine why the lifting device was upgraded from 15-ton to 20-ton capacity.

NFS reported crane issues in Weekly Summaries 96-51, 96-48, 96-42, 96-31, 96-14, and 96-01. Weekly Summary 96-48 reported that on October 22, 1996, at Hanford, a cable separated from its assembly on an auxiliary hook of a 40-ton crane because the weight of a tank exceeded the cable maximum rated capacity. A field superintendent calculated the tank weight to be 4,000 pounds; the actual weight was 15,700 pounds. (ORPS Report RL-BHI-NREACTOR-1996-0017 and Lessons Learned List Server 1996-RL-FDH-0058)

DOE 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter VIII, “Control of Equipment and System Status,” states that it is imperative that equipment and systems in a DOE facility be properly controlled. DOE facilities are required to establish administrative control programs to handle configuration changes resulting from maintenance, modifications, and testing activities. Chapter X, “Independent Verification,” states that independent verification is the act of checking that a given operation conforms to established operational criteria. The chapter also states that components that are critical to ensure safe and reliable operation should receive an independent verification when circumstances warrant. The chapter further states that periodic checks should be made to verify equipment is fully functional. Chapter XVIII, “Equipment and Piping Labeling,” states that labels should be consistent with the information contained in facility documentation. The chapter also addresses the verification of labels.

DOE-STD-1090-96, Revision 1, *Hoisting and Rigging*, section 3.3, discusses qualification of designers of special lifting fixtures; fabrication of the fixtures; inspection and testing before initial use of fabricated equipment; storage, maintenance, and control of fixtures;

and the modification and repair of fixtures. Chapter 14, "Below-The-Hook Lifting Devices," discusses design and fabrication, the marking of the lifting device, inspections, and testing of the lifting device. ASME B30.20-1993, *Below-The-Hook Lifting Devices*, chapter 20-1, applies to the classification, construction, inspection, installation, testing, maintenance, and operation of structural and mechanical lifting devices. Facility managers should review these sections of the standard and the ASME code to ensure facility equipment is in compliance with the standard and the code. They should also verify the documented capacity of lifting devices with the marked capacity on the lifting device.

KEYWORDS: lifting device, hoisting and rigging, testing

FUNCTIONAL AREAS: hoisting and rigging, industrial safety, licensing and compliance

4. DEFICIENT PROTECTIVE COATINGS AT NUCLEAR POWER PLANTS

On March 24, 1997, the Nuclear Regulatory Commission (NRC) issued Information Notice 97-13, "Deficient Conditions Associated with Protective Coatings at Nuclear Power Plants." The notice describes instances in which licensees did not properly apply or maintain protective coatings or qualify them for the intended use. Failure to do so jeopardized the operability of safety-related equipment at their plants. (NRC Information Notice 97-13)

Protective coatings are used in many applications. They are used to protect the inside surfaces of storage tanks and containment liners from corrosion and to protect the inside surfaces of piping systems from erosion and corrosion. Coatings can also seal exposed concrete surfaces, provide skid-resistant surfaces for walking, or control contamination.

The following are examples of instances where protective coatings were not properly applied, maintained, or adequately qualified for their intended use.

- A licensee reported finding pieces of a coating material in a recirculation spray heat exchanger. The coating material had been applied to the inside surfaces of a service water system. Although the pieces were relatively small, they could have prevented the heat exchanger from performing its intended safety function. The licensee determined the pieces came from a second application of the coating material that had delaminated. They also determined their procedures for field application of the second coat of the protective material were not adequate to ensure proper bonding.

- A licensee reported 50 percent of the concrete floor coatings inside the containment building showed extensive failure as a result of mechanical damage and wear. Five percent of the coatings associated with a concrete wall and liner plate inside the building were also degraded. The licensee determined an unqualified coating system had been applied to various surfaces. Documentation could not be found for touch-up work applied to many of the liner plates and concrete wall surfaces.

- A licensee reported delamination of a protective paint from the containment floor. Investigators determined contributing factors were: (1) paint thickness that exceeded the manufacture's specifications by twice the allowable amount; (2) excessive paint shrinkage caused by using too much paint thinner; (3) surface area that was not properly cleaned and prepared before the application; and (4) inspection and documentation requirements that did not conform to American National Standards Institute N101.4, “Quality Assurance for Protective Coatings Applied to Nuclear Facilities.”

The failure of coatings to adhere to exposed surfaces inside containment buildings and to the internal surfaces of fluid systems can result in clogged strainers, filters, and nozzles and can compromise the ability of safety-related equipment to function properly. Industry standards for coatings, as well as vendor instructions and recommendations, provide guidance pertaining to surface preparation and cleanliness requirements, temperature control, humidity control, timing requirements for multiple coat applications, application methods, and personnel qualification and training requirements. Testing and periodic inspection of protective coatings may be necessary to ensure the coating was adequately applied and remains intact.

Coatings that can affect safety-related equipment are governed by Title 10 of the Code of Federal Regulations, part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.” Criterion IX of Appendix B, “Control of Special Processes,” states: “Measures shall be established to assure that special processes . . . are controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements.” Regulatory Guide 1.54, *Quality Assurance Requirements for Protective Coatings Applied to Water-Cooled Nuclear Power Plants*, provides guidance for compliance with these quality assurance requirements as they relate to protective coating systems that are applied to ferritic steel, aluminum, stainless steel, zinc-coated (galvanized) steel, and masonry surfaces.

Copies of NRC information notices may be obtained from the NRC Public Document Room, (202) 634-3273. NRC information notices, bulletins, and generic letters are also available on the Fedworld Bulletin Board System. The system is accessible through a modem by dialing (800) 303-9672 (N-8-1, 9600 baud).

KEYWORDS: coatings, protective, corrosion, erosion

FUNCTIONAL AREAS: operating experience, construction, design

FINAL REPORT

1. FINAL REPORT ON CHLORINE LEAK AND BUILDING EVACUATION

On March 26, 1997, the facility manager at the Lawrence Livermore National Laboratory issued the final occurrence report on a chlorine gas leak that resulted in a building evacuation. On January 26, 1997, a pressure relief valve connected to a chlorine gas manifold failed, allowing chlorine to escape. The chlorine detection system automatically actuated to isolate the leak and activate the building evacuation alarm. No one was injured as a result of the event. Chlorine gas is hazardous because it can burn human tissue and cause asphyxiation. (ORPS REPORT SAN--LLNL-LLNL-1997-0004)

Investigators determined the root cause of the event was facility purging practices that accelerated the failure of the relief valve. Workers purged chlorine gas lines with nitrogen at a pressure higher than the normal chlorine gas operating pressure. This practice reduced the number of purging cycles required to remove the chlorine. However, the higher pressure placed additional stress on the relief valve and shortened its operating life in the corrosive chlorine environment. Corrective actions for the event included modifying the purging procedures to ensure the nitrogen pressure purge pressure will be the same as the system operating pressure. Work practices were also modified to ensure that workers are observant and followup on any indication that there is a problem with the chlorine gas system, no matter how subtle it may be.

Chlorine typically has a characteristic sharp penetrating odor above 3 to 5 ppm. According to Nuclear Regulatory Commission document NUREG/CR-3551, *Safety Implications Associated with In-Plant Pressurized Gas Storage and Distribution Systems in Nuclear Power Plants*, the minimum concentration of chlorine necessary to detect odor is 3.5 ppm. At higher concentrations, severely irritating and painful effects make it unlikely that anyone would remain in the area. Low concentrations irritate mucous membranes, the respiratory system, and the skin.

This event is similar to a March 13, 1996, event at the Ames Laboratory. Four people were exposed to toxic fumes when a pressure regulator connected to a cylinder released hydrogen-sulfide gas. The employees were exposed after a researcher opened the cylinder isolation valve. One researcher was overcome by fumes and lost consciousness, and another researcher pulled him to safety. Hidden damage to a spring in the relief device of the pressure regulator caused the release and exposed the employees. Investigators examined the regulator and determined the spring in the relief device was probably damaged by stress-corrosion damage from the hydrogen-sulfide gas and possible sulfuric acid by-products. (OEWS 96-12 and ORPS Report CH--AMES-AMES-1996-0001)

Corrosive gases such as chlorine may expedite deterioration and failure of gas cylinder systems and components. Maintenance personnel should be aware of these properties and develop inspection programs for cylinder systems and components containing corrosive gases. NFS issued DOE/EH-0527, Safety Notice 96-03, “Compressed Gas Cylinder Safety,” which describes events at DOE facilities involving compressed gases and the effects of corrosive gases. Safety Notice 96-03 can be obtained by contacting the Info Center, (301) 903-0449, or by writing to ES&H Information Center, U.S. Department of Energy, EH-74, Suite 100, Century XXI, Third Floor, Germantown, MD 20874.

DOE O 440.1, *Worker Protection Management for DOE Federal and Contractor Employees*, cites applicable OSHA regulations and requires a written worker protection program that ensures a place of employment free of recognized hazards. OSHA regulation 29 CFR 1910.101 states that the in-plant handling, storage, and use of all compressed gases in cylinders shall be in accordance with Compressed Gas Association Pamphlet P-1, “Safe Handling of Compressed Gases in Containers.” The pamphlet can obtained from the Compressed Gas Association, by calling (800) 827-5242.

KEYWORDS: regulator, relief valve, hazardous gas

FUNCTIONAL AREA: industrial safety, mechanical maintenance

OEAF FOLLOWUP ACTIVITY

For several years Dick Trevillian has been the OE Weekly Summary project sponsor. During this time he has actively encouraged the feedback of operating experience and the exchange of information among DOE nuclear facilities. Dick recently accepted a transfer from the Office of Operating Experience Analysis and Feedback (EH-33) to the Office of Enforcement and Investigations (EH-10). The Operating Experience Group extends a fond farewell and best wishes to Dick as he accepts new challenges.

Individuals who would like to contribute information, provide additional pertinent information, or identify inaccurate statements in the summary, and those who have questions regarding the OE Weekly Summary, should contact Neil MacArthur, (301) 540-2396, or at Internet address neil.macarthur@hq.doe.gov.